

DOCUMENT RESUME

ED 421 972

IR 018 944

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 TITLE Personal and Interpersonal Development of Humans in High Technology Environments.
 PUB DATE 1998-04-00
 NOTE 20p.; Paper presented at the Biannual Meeting of the International Society for the Study of Behavioral Development (ISSBD) (15th, Bern, Switzerland, July 1-4, 1998).
 PUB TYPE Reports - Research (143) -- Speeches/Meeting Papers (150)
 EDRS PRICE EDRS Price MF01 Plus Postage. PC Not Available from EDRS.
 DESCRIPTORS Computer Anxiety; *Computer Attitudes; *Computer Interfaces; Computer System Design; Futures (of Society); *Individual Development; Individual Differences; *Information Technology; Literature Reviews; *Man Machine Systems; *Psychological Characteristics; Self Actualization; Success; Technological Advancement
 IDENTIFIERS Computer Use; Computer Users; Multimedia Technology; *Technology Utilization

ABSTRACT

This paper discusses psychological effects associated with the latest technology in computer interfaces. Emphasis is given to issues involved with multi-media systems and the development of the self on emotional, intellectual, and social levels. A review of technology attitudes and individual differences is presented in relation to the voluntary use of technology; this is contrasted with psychological measures associated with the rejection of technology. Consideration is given to which psychological measures are typically cited by the literature as being associated with emotional, intellectual, and social "success"; these are compared with measures which appear to predict successful technology adoption. The likely effects of the latest trends in technology on the mental world in which a developing self operates, including the effects of new technology such as exploratory multi-media teaching systems, virtual reality, and "GroupWare" are summarized. Reviews of design solutions that have been explored with this technology are emphasized, and psychological issues introduced when computer interfaces provide user populations with multi-sensory experiences are summarized. The paper concludes with a discussion of other issues and factors that determine what makes an effective design solution within the paradigm of increasing design spaces and diverse user populations, including intellectual and emotional effects of multi-media systems on the development of the self and group in a rapidly changing technological environment. (Contains 142 references.) (AEF)

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PERSONAL AND INTERPERSONAL DEVELOPMENT OF HUMANS IN HIGH TECHNOLOGY ENVIRONMENTS

Symposium on Information Technology and New Trends in Human Development

XVTH BIENNIAL MEETING
INTERNATIONAL SOCIETY FOR THE STUDY OF BEHAVIOURAL DEVELOPMENT
Bern, Switzerland. July 1st - 4th 1998

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Abstract

The authors discuss some of the psychological effects associated with the increasing capabilities of the latest technology in computer interfaces. This discussion is done with a particular emphasis on issues involved with multi-media systems and the development of the self on emotional, intellectual and social levels. The presentation includes a review of technology attitudes and individual differences in relation to the voluntary use of technology and contrasts that with the psychological measures associated with the rejection of technology. Consideration is given to which psychological measures are typically cited by the literature as being associated with emotional, intellectual and social "success" and compares that with those measures that appear to predict successful technology adoption. These different measures and outcomes are compared to see if they are compatible. The authors then summarise the likely effects of the latest trends in technology on the mental world in which a developing self operates. This consideration includes the effects of new technology such as exploratory multi-media teaching systems, virtual reality, and so called "GroupWare". Particular emphasis is given in this section of the presentation to the reviews of design solutions that have been explored with this comparatively new technology and summaries of the psychological issues that are introduced when computer interfaces provide user populations with multi-sensory experiences. The paper concludes with a discussion of other issues and factors that determine what makes an effective design solution within the paradigm of increasing design spaces and diverse user populations. These issues included the possible intellectual and emotional effects of multi-media systems on the development of the self and group in a rapidly changing technological environment.

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Introduction

In this paper we will attempt to review the many factors that are involved with the development of the self in the increasingly technological environment. These are complex issues but we will show that human mental development is being increasingly influenced by technology that is often created solely for the purpose of profit or for the sake of technological innovation with little or no thought for the consequences for the human psyche. We feel these problems will grow in importance over the coming decades and that the software and hardware designs of today will literally shape both our physical and mental worlds. This is because there is no part of modern human life that is not touched or moulded by technology. From the humble toaster that makes our breakfast to the mobile telephone systems and email networks that allow us global communications, technology forms every part of our world.

Psychological Effects Associated with Technology

The most frequently reported psychological effects associated with technology are computer phobia and computer addiction. Although there are other effects they are often highly individual in nature and require specialised attention.

Computer Phobia

The anxiety and additional stress that are suffered by users of computers have long been recognised by psychologists (Jay, 1981). The classic three symptoms of computer phobia being resistance to talking about computers, having fear or anxiety towards computers and having hostile or aggressive thoughts towards computers. Work with specially designed computer phobia questionnaires revealed three nearly independent measures of computer phobia (Rosen, Sears & Weil, 1987). Namely, computer anxiety, computer cognition and computer attitudes respectively. This research found that while older people tended to be more anxious about computers they did not have more negative feelings towards them. However this work did find that females tended to have more negative feelings towards computers than men do. Our own research (Morgan et al, 1991) has found that computer phobics are resistant to change and report feelings of fear if they imagine situations where they are seen not to know how to use new technology. Analysis that compared computer phobics with non-phobics shows that the attitudes and gender of the person introducing the technology was vital in determining later feelings towards technology (Weil et al, 1990).

The Seven Technological Ages of Man

Pre-conception

Infertility
CAT Scans
Diagnosis in Hospital

Birth

Computer Controlled Hospitals
Computer Controlled Homes
(Heat, Water, Food)

Childhood

Education
Computer Games
Interactive TV
Internet

Adolescence

Education
Libraries
Electronic Communication

Majority

Management Information Systems
Stock Exchange
Flight and Holiday Booking

Maturity

Diagnosis in Hospital
Email contact with the family

Retirement

Intensive Care
Family Links

Computer Addiction

In contrast, studies which have attempted to investigate computer addiction have concentrated on groups such as intensive computer game players and habitual Internet users (Kestenbaum & Weinstein, 1985; Wilder, Mackie & Cooper, 1985; Braun, Goupil, Giroux & Chagnon, 1986; Morgan et al, 1993). Symptoms of computer addiction are reported to include a preference for computer based interactions to normal social interactions, having obsessive computer based working hours and practices and finally a lack of interest in social norms such as eating and washing. In most studies into this area computer addicts have been found to be highly introverted individuals with poor interpersonal skills.

Computer Attitudes

Three Main Symptoms of Computer Phobia

Resistance to talking about computers.

Fear and / or anxiety towards computers.

Hostile and aggressive thoughts about computers.

Three main Symptoms of Computer Addiction

Prefers computing to 'normal' social interactions.

Obsessive computer based working hours and practices.

Lack of interest in social norms (eating, washing etc)

Investigations into computer attitudes are as old as computers themselves. As far back as the 1960s medical practitioners were facing the introduction of technology into areas which had previously been unmechanised (Reznikoff et al, 1967). Workers reported increased stress levels and anxiety with this change in working practice. Although there were no existing technology attitudes measures at that time psychologists recognised the problem and used an existing tool, The Minnesota Satisfaction Questionnaire (MSQ), to measure responses to introduction of new computer systems (Cheney & Dickson, 1982). The MSQ measured the extent of the dissatisfaction but not what caused the problem. In recognition of these shortcomings psychologists attempted to increase their measures to include mood and arousal (Cruickshank, 1982) or internal locus of control.

The first attempt at a formal definition of computer anxiety came in Raub's (1981) creation of the ATTCQ (ATtitudes Towards Computers Questionnaire). This identified computer anxiety as a state anxiety in which the computer formed the personality-threatening stimulus. Further research identified this as a multidimensional construct formed of computer appreciation, computer usage and general anxiety concerning the possible negative impact of computers on society. Raub also found that academic major, experience and gender were the major correlates of computer anxiety. Amongst these past experience with computers and mathematical anxiety were found to be the strongest factors. Raub also reported that males were more likely to have trait-anxiety towards computers than females.

Gressard & Loyd (1984) performed the first major review of technology attitude work and measures. This work produced the Computer Attitudes Questionnaire (CAS). This measured computer liking, confidence and anxiety in a simple Likert format. Results from using the CAS showed that computer anxiety was negatively correlated to computer confidence and moderately (positively) correlated with mathematics anxiety (Fisher, 1986). This suggests that the 3 subscales may not be independent as these may all be measures of computer anxiety. Follow up studies with the CAS (Gressard & Loyd, 1986) showed that computer anxiety was especially likely in situations where subjects dislike or lack confidence with the computer. This work also found that there was correlation between computer anxiety and anxiety about mathematics. They were one of the first to propose that exposure to computers in a non-threatening way might alleviate computer anxiety. Further work by Loyd & Gressard (1987) found that past experience

of computers was the strongest negative correlate to computer anxiety. Interestingly, since popular culture often suggests otherwise, these studies also reported that females exhibited more positive computer attitudes than males.

On a more global or social scale the Cybernetics Attitudes Scale (Wagman, 1983) attempted to investigate societies attitudes towards the introduction of computers in 10 sectors of society. For example, criminal justice, mathematics, statistics, counselling and medicine. These studies reported that males were much more inclined to think that introducing technology in these sectors would be positive. However both genders had strong reservations about the introduction of computers into medicine and counselling.

Arndt, Clevenger & Meiskey (1985) reported one of the first attempts at a semantic differential test for computer attitudes. The differentials investigated included Pleasing and Unpleasing, Helpful Vs Ineffective, Good Vs Bad (effect on society), Dominant Vs Submissive, Easy Vs Hard and Warm Vs Cold. Those people who were experienced with computers reported seeing the computer as warm, pleasing, submissive, effective and easy to use.

When we look at studies that investigated the long-term introduction of technology into typical office environments we find a traditional male domination of skills; authority and computer based decision making. For example a longitudinal survey which looked at 26 different private sector businesses (45% male workforce) which had just introduced computer technology found that, when the analysis was corrected for job category, women were more satisfied with computerisation. Males reported more problems with regards to computer access, software ad help (Gutek & Bikson, 1985).

Mechanical Competence and Computer Anxiety

Researchers who have attempted to investigate the possible link between mechanical competence and computer anxiety or addiction have found that in addition to the traditional correlation of computer anxiety to math anxiety the role of mechanical competence appears strong (Heinssen, Glass & Knight, 1987; Morgan et al, 1991). Individuals with little previous experience with mechanical devices tended to have negative attitudes towards computers. It has been found that during computer interaction computer anxiety was associated with lower expectations, poorer task performance, greater state anxiety, debilitating thoughts and physiological arousal. Researchers proposed that these findings were consistent with a cognitive-attention theory of computer anxiety (Heinssen, Glass & Knight, 1987) and contrary to popular stereotypes studies on early childhood have found there are no differences in mechanical competence between boys and girls (Brown, 1991).

Summary of Computer Attitudes.

Prior experience with computers played an important part in computer attitudes.

Mechanical competence appeared to be negatively correlated with computer anxiety.

Computer Attitudes were related to anxiety.

Computer anxiety was related to Mathematical anxiety.

There were large geographic and Socioeconomic factors influencing these findings.

All of this research leads to the conclusion that a consistent factor in technophobia is stress (Harrington, 1989; Kreuger, 1989; Hudiburg, 1989). When we look at the rates of change in our environment we will begin to see why technostress is so widespread in our world today. More worrying is the prospect that the problem will get worse in the future when populations from less technologically advanced cultures get their first exposure to the technology (Morgan, 1998). Having considered some of the issues involved in our attitudes towards technology we will now try and review the role of individual differences in technology use.

Individual Differences

Over the past hundred years psychologists have attempted to identify individual differences that explain the multifaceted aspects of the human psyche when it interacts in its environment. However it is only relatively recently that psychologists have tried to explore the role of individual differences in relation to technology. Researchers in the area of human-computer interaction have declared the goal of identifying these differences as they relate to technology use, preference and attitudes. They hope to use their findings to design technology which adapts to the users needs (Egan, 1988; Rich, 1983, Abler & Sedlacek, 1897; Benyon et al, 1987; Morgan & Macleod, 1990). It is felt by many that technology that could adapt to match the various psychological differences inherent in each of us would have a much better chance to blend harmoniously into our lives (Benyon et al, 1987; Morgan & Macleod, 1992). There are numerous individual differences which can be explored (Morgan, 1995) such as spatial ability, memory, mathematical ability, technology attitudes, technological aptitudes, age, gender, cultural or social background, cognitive style and historic influences. Of these gender (Morgan et al, 1991) and cognitive style (Messick, 1976) have been most extensively investigated by psychological researchers in the area of human computer interaction.

Cognitive Style.

The idea of a cognitive style or set of high level cognitive heuristics that organise behaviour is not new. If we examine the works of the ancient Greeks we find numerous references to mental types that influence behaviour. In more recent times the work of Witken and Goodenough (1962, 1977, 1979, 1981) in developing their theory of psychological differentiation has had a major influence on adaptive computing interfaces. However we are still a long way from technology that maps our cognitive style to optimise our efficiency (Morgan et al, 1995).

Gender

One of the most fundamental individual differences is that of gender and it is also one of the most controversial (Block, 1976; Maccoby, 1980; Demo, 1982; Caplan, 1985; Caplan et al, 1985; Elliot, 1986; Halpern, 1986; Hiscock, 1986). The explanations which have been put forward to explain gender differences are well known and include visiospatial skills (Kaplin, 1980), Mathematical ability (Maccoby & Jacklin, 1974 & 1980), genetic (Stafford, 1961; Hutt, 1972; Bouchard & McGeo, 1977) and hormonal differences (Broverman, 1977), cerebral lateralization (Buffery & Grey, 1972), and social roles (Sharpe, 1976). Although computing is dominated by males (Reznikoff, 1967) there appears to be no real agreement to any rational reason for this domination. Indeed there are those who argue that even to investigate this gender bias in computing and high technology is sexist (Fowler & Murray, 1987). Over the past 40 years of research into the usability problems which people face using new technology only 2% of studies have investigated gender specifically (Hudgens & Billingsley, 1978). Analysis of the literature shows that there is a significant gender bias in the sample populations of usability investigations, in favour of males. Little wonder then that the end products of high technology favour male use and technological domination (Gomez et al, 1984).

Those studies that have compared male and female computing performance have reported some interesting differences between the sexes (Morgan et al, 1991 & Morgan, 1995). These differences in behaviour when using new technology includes males increasing their task speed in detrement to their error rates (Baker et al, 1984) and males also being more prone to making more errors under conditions of stress and environmental distraction. Males have also been reported to prefer competitive task feedback (Lewis & Cooney, 1987) whilst females tended to prefer non-competitive feedback. Studies that investigated the effects when male and female computer users are administered alcohol reported that the males were more prone to increase their confidence in their ability to perform computing tasks than females (Crow & Hirdler, 1985).

When we examine reviews of the kinds of recreational computing tasks preferred by males and females the literature reports that males are the major users and buyers of computer video games (Harris & Williams, 1985), while females use the computer for social purposes. This raises the question of the different motivations which prompt people to adopt new technology and if the social role or 'image' associated with the use of certain items of technology influence this preference. In order to investigate these questions we must review some of literature regarding 'success' and the ways in which high technology environments mould our behaviours and self image.

Psychological Measures Associated with Success

To many people in the modern world being 'successful' implies having high levels of technological competence. However in psychological terms the concept of "Success" is not simple and the psychological literature recognises many categories such as, emotional, intellectual and social success. One might predict that highly technically competent people would invariably be recognised as successful, however popular culture is filled with images of the 'computer geek' who is socially incompetent. Research into the psychological measures which most clearly predict what is commonly recognised as

Successful people

Have significantly fewer irrational beliefs than other groups.

Are focused on acquiring techniques and strategies for effective living and preparing for technological, social and economic change.

(Morris, 1992).

'success' report that successful people possess significantly fewer irrational beliefs than other groups and that they focus on acquiring techniques and strategies for effective living and preparing for technological, social and economic change (Morris, 1992). It is also recognised that self esteem is a most important factor in predicting success (Crowder & Michael, 1991). In contrast it is also recognised that people often consider they have "failed" because they feel incompetent (Badawy, 1988), or rather have been given the image of their incompetence by their perception of the environment. It is therefore vital that the technology that creates our environment always supports a positive self-image in its user population.

Embedded Identities in Technology.

It is felt by some that gender and culture are embedded into machines and technology (Helmers & Buhr, 1995; Garaway, 1994). As an extreme example many pregnant women report experiencing a diminished sense of competence in the face of sophisticated technology (Gregg, 1994). Some researchers even go so far as to propose that normality is defined by the technology we create (Law, 1993), so design decisions such as screen font sizes and keypad sensitivity may define whole segments of previously 'normal' people as being handicapped or lacking in some vital sense. Obviously this has dramatic implications for a future in which technology is changing so rapidly. Our modern world has produced a situation where social norms have changed within the space of a generation and this rate of change is likely to increase in the future. Poor or badly designed technology will invariably lead to increased pressure on psychic stability and reveal more psychic problems.

Psychological Development and the Influence of Environment

There has always been the debate within psychology with regard to the respective roles of the environment and the genetic makeup of the individual, often called "nature and nurture". However few psychologists would question how important the environment is in the shaping of the individual. Indeed many think it is the most important factor in the future development of the person (Doxiadis, 1989). Although we have no clear cut theory to explain our attitudes and behaviour when we encounter new items in our environment (Fulk, 1990), as we have seen in our review of technology attitudes, there are some established influences, such as the long standing

finding of strong links between technology attitudes and mathematical aptitude (Munger & Loyd, 1990). Recent research has established that the modernisation of human environments stimulates, restricts and modifies human behaviour (Kaitilla, 1995).

Changes in Modern Environment

The modern environments in which humans find themselves are in a constant state of change and the rate of this change is becoming more and more rapid. As we will see in our review of the trends in new hardware technology this problem is likely to become worse for future generations. Any change in an established environment produces stress in the organism but this constant state of change in our lives can be shown to be harmful. The most focused research into these issues have been performed by occupational psychologists. They have found that stress introduced by new working practice and methods influences mood, physical well being and work performance (Stewart & Barling, 1996). Other research has shown that many workers feel that computerisation makes work more difficult, increases stress levels and introduces the mental cycles of low self-image and failure (Seppaelae, 1995).

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The Motivation for Adopting to Change.

If changes can be so harmful for us we should enquire why people would opt for such a dynamic situation. In truth most of us are not given the freedom of choice. Research which has tried to identify the motivational categories for using new technology has reported finding four motivational clusters that produced behavioural reactions to new technology. These were security consciousness, maximizers, instant gratifiers and hassle avoiders (Barczack et al, 1997). These findings were consistent over both sexes. This suggests that people adopt these new technologies into their environment in the hope of some improvement in their life-style.

Introductions of Technology into Developing Cultures.

All the problems that we have discussed with regard to technological change are multiplied when we consider technological introductions into less developed cultures. There are many examples where technological introductions into less advanced cultures have produced social and economic disasters for the indigenous peoples (Romalis & Romalis, 1983). Thankfully there is now recognition, at least among academics, that when dealing with less technologically developed cultures there is a vital need to respect the local value belief systems (Sinha et al, 1989; Morgan, 1998). If this is not done then the consequences can be drastic changes to parts of the social structure. For example, workers in less developed cultures who are forced into western type working environments rapidly adopt western work ethics and practices (Form & Bae, 1988). Researchers who have specialised in this area of technological introduction have reported that no aspect of the culture is immune when more advanced technology is introduced into these less technologically advanced societies. Even the political culture is influenced by technology and innovation (Wilson, 1997). In order for the introduction to be successful seven components have been identified which are vital to effective future development. They are need identification, appropriate resources, correct technology, social conscience, integrity, attitude and problem solving (Dorsey, 1989). However, we should not think that the role of new technology is all bad, technology has been shown to break cultural biases that exist in communities (Freedman & Liu,

1996). On a more practical level, researchers who have investigated how to change negative attitudes towards technology in less advanced cultures have found the school teachers attitudes are vital in determining their students own attitudes towards new technology (Mordi, 1991). It is interesting to note that this finding is identical to that reported as the determining factor for computer phobia.

If we, as professionals, are to be ready to help advise on the psychological challenges which will face us when high technology environments are introduced to previously low technology cultures we must identify what kinds of new technologies we are likely to face in the immediate future.

The Trends of the Future : Multi-Media and Beyond.

The term multi-media has become accepted within computing to mean a system which allows the presentation of additional computer interface output beyond the traditional text only output. However with the rapid advances in computing what might have been considered multi-media to researchers and workers such as Kresten Bjerg (1984) in the early 1980s are now part of the standard working interface on many computer systems and may no longer be considered worthy of human-computer interface research. This thought leads us to a possible problem of definition for a multi-media research project, which may lead over several years. It is not only the rate of longitudinal change which causes the problem it is the way in which the 'norm' and expectation for behaviour and ability of computing interfaces evolve to match the power and features available. For example including interactive digitised moving pictures and sounds in computer output is no longer the exclusive domain of research scientists with large budgets and state of the art systems. Children's game machines now provide facilities and rely on interaction techniques that we have had very little time to develop interaction rules for, let alone understand the complex mental processes involved. It is our goal in this section of the paper to explore and try to identify some of the possible problems involved with the growing psychic spaces which exist in truly interactive multi-media systems. Other people have reviewed multimedia from different perspectives, for example the possibility of the new medium for exploitation (Alty, 1991), the possible uses of multimodality (Larson et al, 1992), the problems and challenges (Tobagi, 1993), and what possible applications we can expect in the future (Teshima, 1993).

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Computer Hardware Shapes Future Developments.

Before we start to look at the considerations with regard to the organisation of the multi-media material and the design of the methods of presentation we will briefly look at the trends in the underlying hardware since hardware will ultimately constrain our future uses of technology as much as the human users limits. If the history of computing is a guide to the future then the hardware is the driving force behind the majority of the future developments in the technological environment experienced by humans.

Multimedia Communications

Multi-media on stand alone systems like personal computers have become standard items and research is now focused on the issues involved when computer based multi media is used to support teams in some collaborative work. Advances in computer network methods over the recent years such as Asynchronous transfer Mode (Chenet, 1992), digital signal processing (Freij, 1992), Multi-media interchange formats (Kinoshita, 1992; Koegel, 1993; Pasquale et al, 1993; Huang et al, 1993; Soares et al, 1993) the development of database support for rapid

storing and indexing of multimedia objects (Riley, 1993) and schemes for multimedia storage management (Anderson et al, 1992; Yu et al, 1993) have all lead to support for multimedia collaborative tools over wide area networks. At the same time as this development of the supporting hardware to enable collaborative or distributed multi-media has been the development of software tools to aid in the design and implementation of collaborative multimedia systems. A typical example of these tools is 'MoodView' (Arpinar et al, 1993) which is a graphical user interface for object orientated database management systems (OODBMSs) which provides support for multi-media applications. Other software tools provide support in potential problem areas such as human lip synchronisation to voice output over interactive distributed systems (Regan, 1993).

Ever since the facilities of multi-media became available its main use has been in teaching or presenting information (Baggett, 1998; Slotnick, 1990; Vainio-Larsson, 1991; Ropa, 1991; Reisman, 1993; Earnshaw, 1993). It is not surprising therefore that when we review the published material on the design of multi-media materials it is predominantly concerned with teaching. Whether it be Jeremy Fox's description of the work involved with the European project on language teaching 'LINGUA' (Fox, 1993) or Simon Shaw's (1993) review of multi-media teaching material, in which he concluded by stating the three design conditions which he felt were present in all successful teaching multi-media systems were: the absence of fear, the presence of openness, and the use of the practical test. One of the best attempts at a general (non-teaching) review of the design of multi-media material was that done by Park & Hannafin (1993) who concluded that the design of material to be included in multi-media systems was usually determined by the feelings of the designer, not any empirically determined guidelines. As we shall see later in the review some researchers think that the application should perform some supporting role in helping to select the multi-media material to be presented (Reisman, 1993).

Trends in Applying Multi-Media

One of the pioneers in the area of multi-media was the Scandinavian Kresten Bjerg who discussed the possible future of multi-media information services in Scandinavian homes (Bjerg, 1984). This was a year earlier than the report on multi-media communications on the DARPA electronic mail system which formed the basis of the modern Internet (Reynolds et al, 1985). Indeed early public teletext systems are cited by some researchers as being a pioneering form of the modern multi-media interface (Alty, 1991; Larson et al, 1992) but it is in teaching and exploratory information systems that multi-media research has concentrated most of its effort. As early as the mid 1980's computer aided teaching researchers were investigating the possibilities offered by multi-media computer systems. The advent of large data storage systems, such as optical discs (Wilson, 1988), allowed the use of digitally encoded visual images and sounds which required more storage than could previously be considered on the standalone personal computer systems available to schools and education. Although there was some early research with regard to the use of voice annotation to electronic documents in commercial settings (Van-Nes, 1988), the amount of the early literature on the non-teaching use of multi-media, beyond CSCW and email, is relatively small. In the late 1980's researchers were already trying to evaluate the methods of teaching which were most appropriate to rich multi-media systems. Such research reported finding that the exploratory nature of multi-media and the possibility to practice dangerous and or expensive procedures made the medium as effective as real-life practice (Baggett, 1988; Earnshaw, 1993). The ability of multi-media systems to mimic reality has allowed many developments in the area of simulation and product design. Current technology means that modern technology can be designed and evaluated before even the first physical prototype is built (Desmarais, 1993).

The 1990's saw a mass of reviews and evaluations of the effect and effectiveness of teaching using multi-media systems (Slotnick, 1990; Vainio-Larsson, 1991). Among this valuable evaluation work are several unique studies which deserve wider coverage. For example, Ropa's work looking at the use of multi-media systems in the facilitation of cross-cultural understanding (Ropa, 1991) and Chung & Chen' (1992) work looking at the use of hyper-media, a specialised

form of inter linked items presented in multi-media form (Nielsen, 1990), as a tool to enhance creativity among teams and individuals. They reported that, since they proposed 'creativity' to be a 'joining of previously unrelated things or thoughts', hyper-media provided a potential method for enhancing creativity by providing tools to permit unique joining of multi-media items. Other researchers have reported on their investigations into the use of hyper-media in creative settings, such as a co-operative writing tool (Murananga, 1993). These researchers believed that using representations of shared information and tools could support creativity by linking previously unlinked items.

Among researchers who have investigated the commercial potential for multi-media much work has concentrated on computer supported co-operative working (CSCW). Researchers who have investigated these mediums for communication and shared work have reported that previously existing organisational hierarchies tend to change their form and become flatter when they switch to this new format (Reynolds et al, 1985; Bodker et al, 1987; Malone et al, 1987; Marca & Bock, 1992). Other researchers have reported that inter-person communication changes and becomes less naturalistic and less symmetrical (Heath et al, 1992). While it has also been noticed by researchers in this field that it is notoriously difficult to design (Grudin, 1988) and evaluate (Tollmar, 1993) these co-operative multi-media environments.

Theoretical Understandings

Although the amount of research directed towards a theoretical understanding of human-computer interaction is large (Newell & Card, 1985) and can be quite complex, (Barnard, 1993) there have been relatively few papers that have attempted to address the theoretical aspects underlying the issues that are associated with multi-media computer systems. Of the few papers that have addressed themselves to these issues, one by Keller & Denning (1991) discussed what they felt to be the major difference between the classic interaction metaphor and the exploratory dimension of discovery available in multi-media. Not surprisingly, given the predominance of teaching applications in multi-media, many of the theoretical papers concern teaching and learning styles and their effects (Carlson, 1991). Most of these papers confine themselves to the importance of matching the students learning style to the type of multi-media interaction.

The Technologies

From our review of the areas of current development in computer hardware we can see that the trends in technological evolution are towards more distributed multimedia communication. This will be a future where instant international multimedia communication becomes taken for granted. Telephony will move toward telepresence and populations in less advanced regions will be introduced to technology that will transform every aspect of their mental worlds. Multimedia databases of knowledge and experiences will be available instantly anywhere on demand. Technology will introduce machines that have all the characteristics of intelligence and these products will by necessity alter the work ethos and ethics around the world. But we know very little about the effects these changes will bring on the psychic aspects of these peoples (Morgan, 1998). The technology that we have already experienced has transformed the lives of all in the developed world. As we have seen in our reviews of technology attitudes these transformations have not all been positive. Some individuals have adjusted well to these changes but as we have seen some have responded in adverse ways, with increased levels of stress and phobia at one extreme and compulsive addiction at the other. When our environment becomes more computer centred and totally virtual what kinds of psychological affects can we expect?

The Future

Telephony will move toward telepresence and populations in less advanced regions will be introduced to technology that will transform every aspect of their mental world.

We know very little about the effects these changes will bring on the psychic aspects of these peoples.

Reported Effects of New Technology

If we examine the current reported behavioural, social and intellectual effects of new technology we find some disturbing results. Investigations into the psychological effects of prolonged computer video games use have found a correlation between heavy video game playing and developmental problems, especially aggressive behaviour (Kestenbaum & Weinstein, 1985). Some researchers have found that in poorly designed computerised education systems students perceive an increase in their workload and pressure (Zuckerman, 1987). There is even evidence that some sections of the population may derive more benefit than others from computer based education. In research which has investigated this it is reported that males learn more with computerised instruction than by any other method including that of a human teacher (Hammond et al, 1997), but this trend was not reported for females. Other research has supported the finding that computerised instruction can be superior to traditional methods (Forsyth & Archer, 1997). Computers can expand human regard for information and change the ways in which we learn through the introduction of new means of information gathering (Marchionini, 1995). Studies that have attempted to investigate ways of increasing computer use and attitudes in the classroom have found that increasing self esteem has the biggest effect in perceived feelings towards computer based instruction. It was also found that the quality of computer based exposure was more important than the amount of time spent using the computer (Ertmer et al, 1995). The value of the quality rather than the quantity of exposure to technology is emphasised by studies which attempted to use a computerised stress measure to predict academic performance on computer courses found a strong relationship between the amount of computer based stress and poor academic performance. The greatest predictor being a lack of previous computer experience (Schmitz, 1992). This is in-line with what Bagozzi (1992) proposed in his Theory Of Trying (TOT), in which he proposed that computer based learning was a goal that was determined by attitudes towards success, failure and the process of goal pursuit. Again we are reminded how vital it is that the technological environment always reinforce positive self images in all who experience it.

Influences of these Technologies

One powerful influence of technology in our culture is the trend to move away from words and language and towards pictures and symbols (Davies et al, 1991). This trend may be dangerous since it has long been recognised that verbal thought is vital in many aspects of high culture within existing civilisations (Ferguson, 1978). It is interesting to note that one of the most compelling aspects of the World Wide Web is its emphasis on pictures and sounds rather than the textual basis of the old Usenet. To many this raises the concern about whether technology is shaping us into passive consumers rather than active producers (Fein, 1987). No wonder then that some have suggested that the only hope for our mental sanity in a highly technological future is to blend the mystical with technology (Glenn, 1989).

Opportunities from New Technologies

As we have seen there are great possibilities from this new technology for the benefit of all humanity. All of the world's people potentially have access to unlimited education. Students from the most remote parts of the world can have access to leading experts. No longer will people be limited by the facilities provided by their local environment for medicine or their intellectual advancement. Problems can be addressed and solved by remote communication methods that are beyond our imagination.

Dangers to the Self and its Development

However as with all possibilities there are potential problems and concerns, for example, who will pay for all this technology? Most of the people who will benefit the most from these possibilities are those who can least afford the huge costs involved. There is a danger that only the wealthy will have access to these things and the gap between the developed and the undeveloped world

will grow (Morgan, 1998). Inequalities that are so obvious today may be exaggerated in the future. Even if the technology is made available to all regardless of social or economic group the question arises who will control and determine the content of the information being transmitted over these systems. A similar concern is over who will control the production and presentation of information, since that control will be a major factor in determining the thought and actions of the worlds population.

Summary and Conclusions.

In this paper we have reviewed the existing literature on technology and its affects on the individual. We have seen that technology has a huge affect on the self-image that each of us possesses and how we interact with the world around us. We are indeed products of our environment and that environment is shaped and controlled by technology. We have seen that media-rich worldwide communications are likely to increase this current effect by orders of magnitude in the near future. As psychologists we have a responsibility to ensure that the future is a safe and positive place for future generations. In the past we have fought hard to introduce the ideal of usability into the design of technology, we have seen in this paper that this old ideal is not enough. When our whole environment is pervaded with advanced technology we need to fight not just for systems which are easy to use but also systems which project a positive self image on all those who come into contact with them.

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